Inventor: NAGAYOSHI et al. Docket No.: 10873.1355US01 Title: SOLID-STATE IMAGE SENSING DEVICE AND CAMERA USING THE SAME Serial No.: 10/712770 Sheet 1 of 35 3:Vertical transfer part Column1 Column2 Column3 Column1 Column2 Column3 В Gb Gb В R Gr R Gr Gr GЬ В GЬ В GЫ В Valid pixels R Gr R Gr R Gr FIG. 1 Gb В GЫ В Gb В R Gr R Gr R Gr

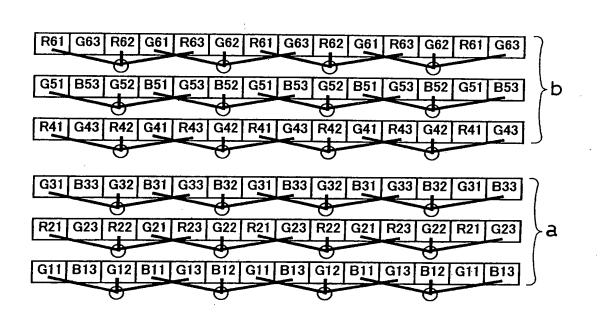
Vertical last stage

of Column 2

Vertical

last

stage



Vertical last stage

of Column 3

2: Photoelectric

Conversion part

4:Horizontal transfer part

FIG. 2

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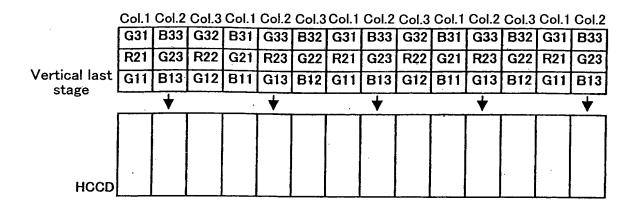


FIG. 3

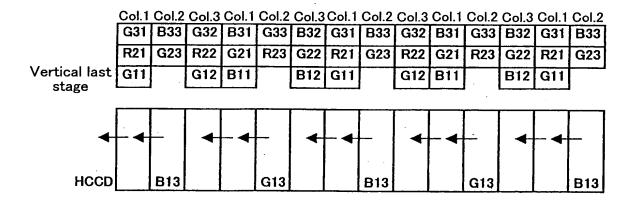


FIG. 4

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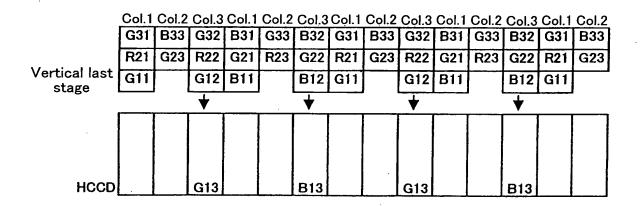


FIG. 5

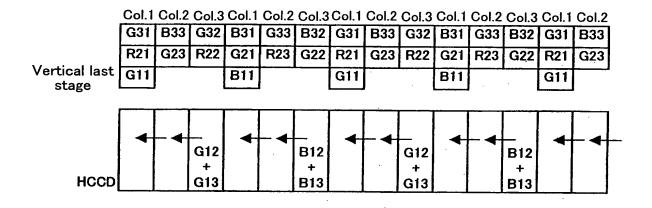


FIG. 6

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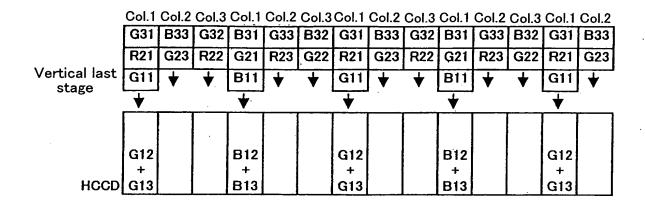


FIG. 7

	Col.1	Col.2	Col.3	Col.1	Col.2									
	R41	G43	R42	G41	R43	G42	R41	G43	R42	G41	R43	G42	R41	G43
	G31	B33	G32	B31	G33	B32	G31	B33	G32	B31	G33	B32	G31	B33
Vertical last stage	R21	G23	R22	G21	R23	G22	R21	G23	R22	G21	R23	G22	R21	G23
							·	·			·	<u> </u>		
1	G11			B11			G11			B11			G11	
	+			+			+			+			+	
	G12			B12			G12			B12			G12	
	+			+			+			+			+	
HCCD	G13			B13			G13			B13			G13	

FIG. 8

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Vertical last stage

														Col.2
	G51	B53	G52	B51	G53	B52	G51	B53	G52	B51	G53	B52	G51	B53
	R41	G43	R42	G41	R43	G42	R41	G43	R42	G41	R43	G42	R41	G43
,	G31	B33	G32	B31	G33	B32	G31	B33	G32	B31	G33	B32	G31	B33

R21	(G11	G21		B11	R21		G11	G21	B11	R21	
R22	(G12	G22		B12	R22	·	+ G12	G22	H B12	R22	
+	· 1	+	+	1	+	+		+	+	+	+	
R23		G13	G23		B13	R23		G13	G23	B13	R23	

FIG. 9

Vertical last stage

_														Col.2
	R61	G63	R62	G61	R63	G62	R61	G63	R62	G61	R63	G62	R61	G63
	G51	B53	G52	B51	G53	B52	G51	B53	G52	B51	G53	B52	G51	B53
	R41	G43	R42	G41	R43	G42	R41	G43	R42	G41	R43	G42	R41	G43

G31	B11	R21	B31	G11	G21	G31	B11	R21	B31	G11	G21	G31	B11
+	+ :	+	+	+	+	+	+	+	+	+	+	+	+
G32	B12	R22	B32	G12	G22	G32	B12	R22	B32	G12	G22	G32	B12
+	+	+	+	+	+	+	+	+	+	+	+	+	+
G33	B13	R23	B33	G13	G23	G33	B13	R23	B33	G13	G23	G33	B13

FIG. 10

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	Col.1	Col.2	Col.3	Col.1	Col.2	Col.3	Col.1	Col.2	Col.3	Col.1	Col.2	Col.3	Col.1	Col.2
	R61	G63	R62	G61	R63	G62	R61	G63	R62	G61	R63	G62	R61	G63
	G51	B53	G52	B51	G53	B52	G51	B53	G52	B51	G53	B52	G51	B53
Vertical last stage	R41	G43	R42	G41	R43	G42	R41	G43	R42	G41	R43	G42	R41	G43
	G31	B11	R21	B31	G11	G21	G31	B11	R21	B31	G11	G21	G31	B11
	G31 士	B11 ±	R21 +	B31 ±	G11 +	G21 +	G31 +	B11	R21	B31 +	G11 +	G21	G31 +	B11 +
•		B11 + B12	R21 + R22	B31 + B32	G11 + G12	G21 + G22	G31 + G32	+	+	B31 + B32	G11 + G12	G21 + G22	+	B11 _+ B12
	+	+	+	+	+	+	+	+	+	+	+	_+	+	_+
4	+ G32	+ B12	+ R22	+ B32 +	+ G12 +	+ G22 +	+ G32 +	+	+ R22 +	+	+ G12 +	_+	+ G32 +	_+ B12

FIG. 11

	Col.1	Col.2	Col.3	Col.1	Col.2									
	G31	B33	G32	B31	G33	B32	G31	B33	G32	B31	G33	B32	G31	B33
	R21	G23	R22	G21	R23	G22	R21	G23	R22	G21	R23	G22	R21	G23
Vertical last stage	G11	B13	G12	B11	G13	B12	G11	B13	G12	B11	G13	B12	G11	B13
otago														
	R61	G41	G51	G61	R41	B51	R61	G41	G51	G61	R41	B51	R61	G41
	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	R62	G42	G52.	G62	R42	B52	R62	G42	G52	G62	R42	B52	R62	G42
	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	R63	G43	G53	G63	R43	B53	R63	G43	G53	G63	R43	B53	R63	G43

FIG. 12

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	Col.1	Col.2	Col.3	Col.1	Col.2	Col.3	Col.1	Col.2	Col.3	Col.1	Col.2	Col.3	Col.1	Col.2
	G31	B33	G32	B31	G33	B32	G31	B33	G32	B31	G33	B32	G31	B33
	R21	G23	R22	G21	R23	G22	R21	G23	R22	G21	R23	G22	R21	G23
Vertical last stage	G11	B13	G12	B11	G13	B12	G11	B13	G12	B11	G13	B12	G11	B13
ocago														
	R61	G41	G51	G61	R41	B51	R61	G41	G51	G61	R41	B51	R61	G41
	R61	G41 +	G51 +	G61 +	R41 +	B51 +	R61	G41 +	G51 +	G61 +	R41 +	B51 十	R61 +	G41 +
.	R61 + R62	G41 + G42	+	+	+	+	+	+	+		+	+	+	
4	+	+	+	+	+	+	+	+	+	+	+	+	+	_+
•	+ R62	+	+ G52 +	+ G62 +	+	+ B52 +	+	+ G42 +	+	+ G62 +	+ R42 +	+ B52 +	+ R62 +	_+

FIG. 13

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:	:
a9 a10 a11 a12 a13 a14 a15 a16 a17 a18	b18
a17	b17
a16	Dummy b7 b8 b9 b10 b11 b12 b13 b14 b15 b16 b17 b18
a15	b15
a14	b14
a13	b13
a12	b12
1 <u>1</u>	P11
a10	b10
a9	69
a8	P8
a7	b7
Dummy	Dummy
Dummy a4 a5 D	p2
a4	p4
Dummy	Dummy
Dummy	Dummy
a	2
Output order of a line	Output order of b line

Two dimensional re-arrangement of mixed pixels at the center of the pixels

		٩			æ			kels	
	_	_ـ	_	_		\neg		e pi	
	b30	b26	b22	a30	a26	a22	1	f thre	xing
	b27	b23	b19	a27		a19	₩	tch o	before mixing
	b24	b20	b16	a24	a20 a23	a16		Horizontal pitch of three pixels	befo
	b21	b17	b13	a21	a17	a13		rizon	
;	b9 b12 b15 b18 b21 b24 b27	b11 b14 b17 b20 b23	b7 b10 b13 b16 b19 b22	a15 a18 a21 a24 a27	a11 a14 a17	a7 a10 a13 a16 a19 a22		운	
	b15	b11	b7	a15	a11	а7			
	b12	89	4	a12	8 8	a4		→ Valid	
•	6 9	p2	b1	a9	a5	a		1	
	ummy Dummy	Dummy		учтту Битту	Dummy			1	_
	Dummy			Dummy				Invalid ←	
						•		-	

Color arrangement of mixed pixels

	٩			Ø			els	
_		_	_	۸_	\neg		e pÿ	
Я	໘	æ	ប	α	ഗ		thre	xing
G	В	ប	В	ប	В	Ţ	ch of	before mixing
В	ប	æ	ß	ď	១		al pit	befo
១	В	മ	В	ប	В		Horizontal pitch of three pixels	
æ	ប	ď	១	2	ບ		운	
໘	В	ഗ	8	ប	Ф			
œ	ប	œ	ប	ď	ഗ		→ Valid	
Ŋ	В	ប	В	ប	В		Ť	
ummy Dummy	Dummy		Dummy	Dummy			1	
Dummy			Dummy				Invalid	
							-	

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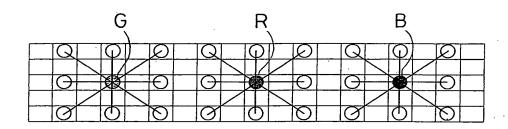
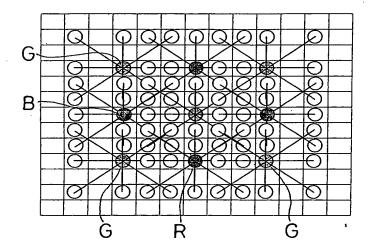


FIG. 15



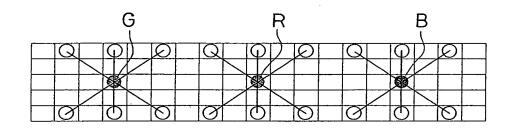
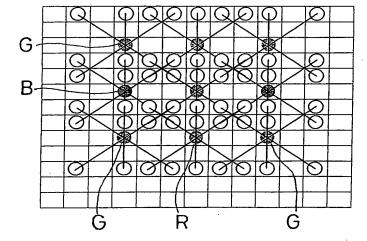


FIG. 16



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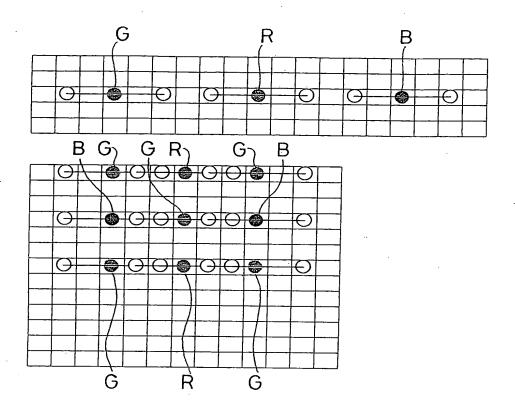
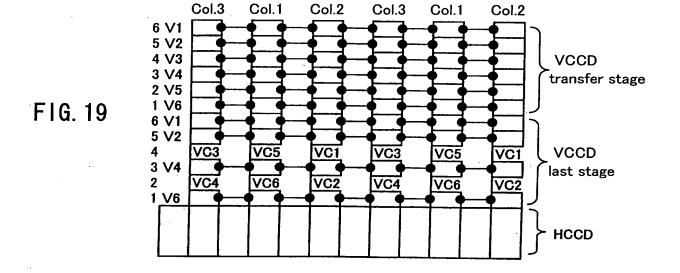


FIG. 17

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Col.3 Col.1 Col.2 Col.3 Col.1 Col.2 6 V1 5 V2 4 V3 **VCCD** 3 V4 transfer stage 2 V5 1 V6 6 V1 FIG. 18 5 V2 VC1 4 VC1 VC3 VCCD 3 V4 last stage VC4 VC4 2 VC2 VC2 1 <u>V6</u> HCCD



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Col.3 Col.1 Col.2 Col.3 Col.1 Col.2 6 V1 5 V2 4 V3 **VCCD** 3 V4 transfer stage 2 V5 1 V6 6 VC5 VC1 VC5 VC1 FIG. 20 5 V2 4 VC6 VC2 VC6 VCCD VC2 3 V4 last stage 2 VC7 VC3 VC7 VC3 1 V6 **HCCD**

Col.3 Col.1 Col.2 Col.3 Col.1 Col.2 6 V1 5 V2 4 V3 VCCD 3 V4 transfer stage 2 V5 FIG. 21 1 V6 6 VC5 VC8 VC1 VC5 VC8 VC1 5 V2 VC9 VC2 VC9 4 VC6 VC6 VC2 **VCCD** 3 V4 last stage VC7 VC10 VC3 VC7 VC3 2 VC10 1 V6 HCCD

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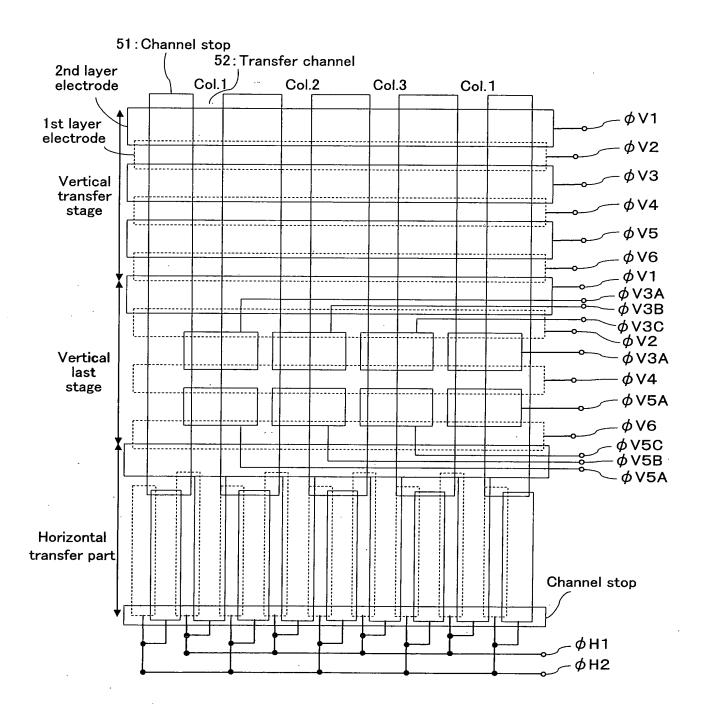


FIG.22

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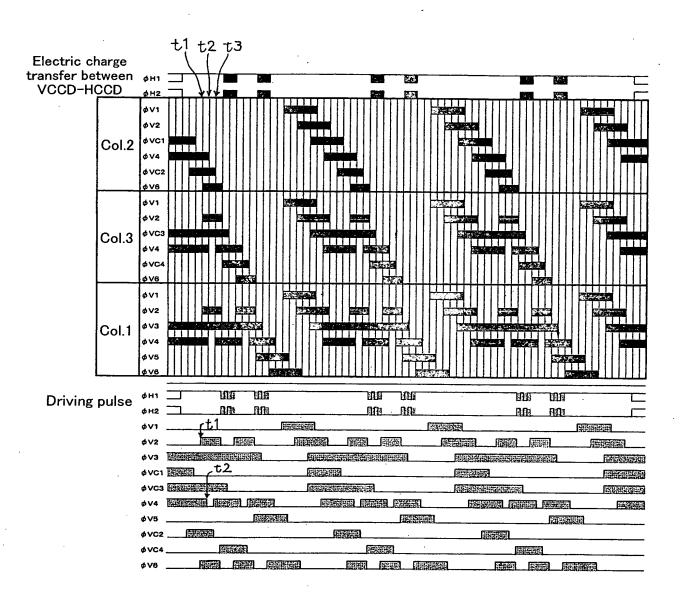


FIG. 23

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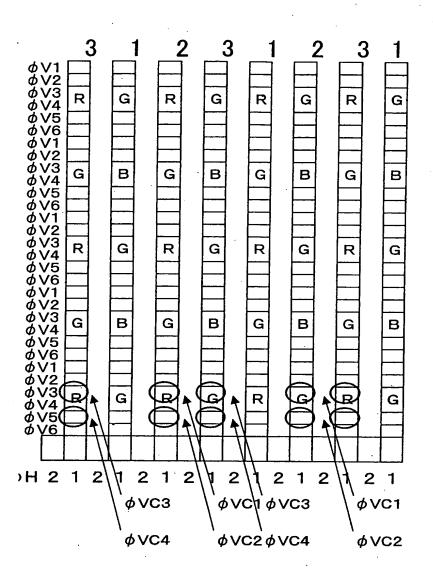


FIG. 24

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Electrode structure

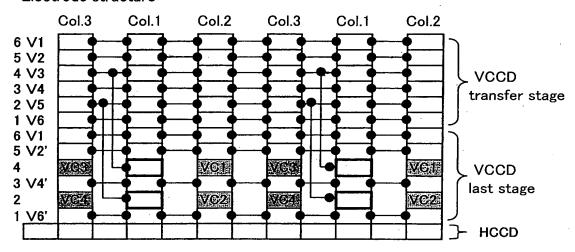


FIG. 25

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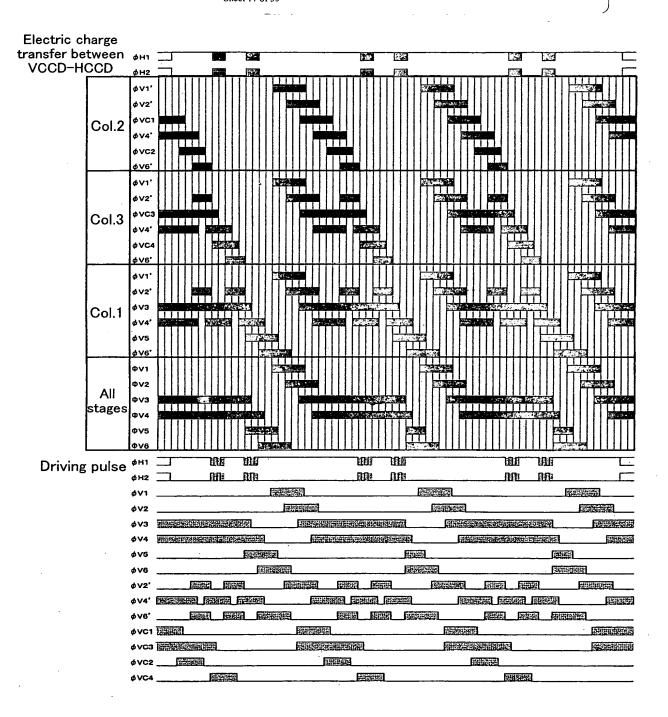
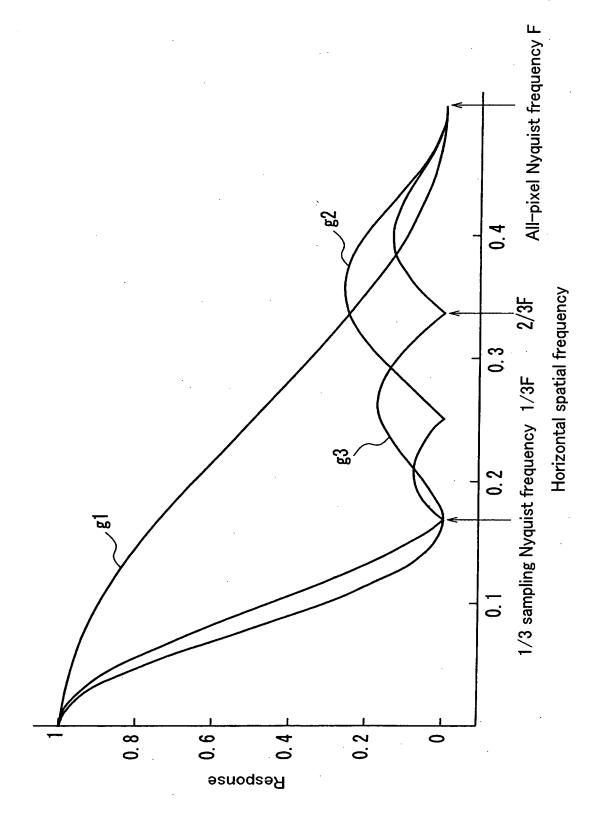


FIG. 26

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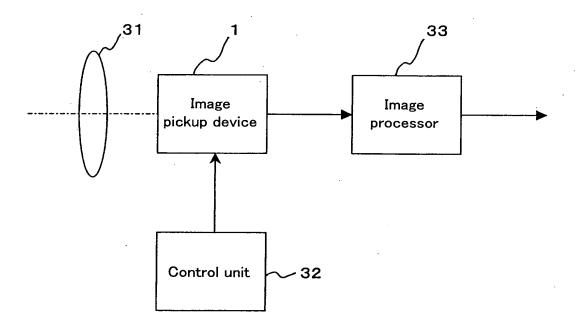


FIG. 28

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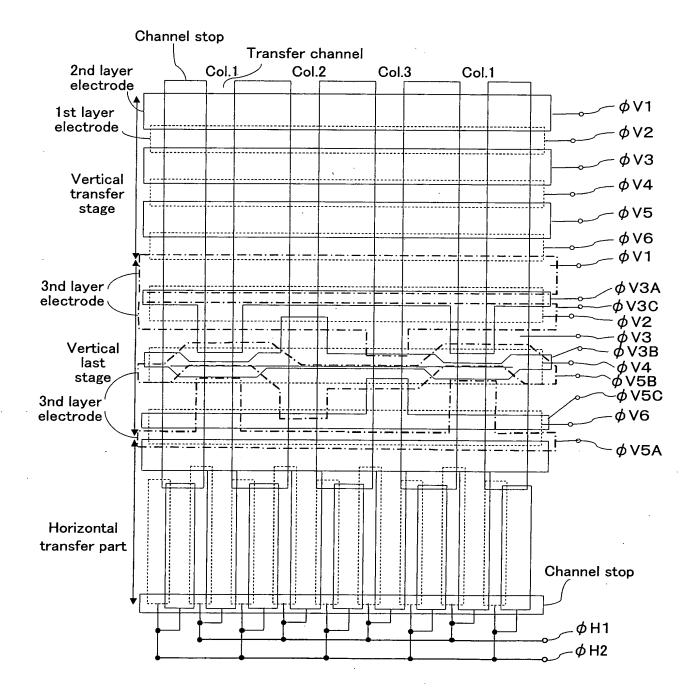


FIG.29

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04			T		<u> </u>	T	T
81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38
21	22	23	24	25	26	27	28
11	12	13	14	15	16	17	18
		-			-		

FIG.30

V last stage

HCCD

FIG.31

V last stage

HCCD

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81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38
21	22	23	24	25	26	27	28
11	12		14	15		17	18

FIG.32

V last stage

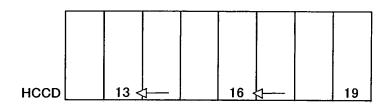


FIG.33

V last stage

HCCD

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				,				
	81	82	83	84	85	86	87	88
	71	72	73	74	75	76	77	78
. <u>-</u>	61	62	63	64	65	66	67	68
	51	52	53	54	55	56	57	58
	41	42	43	44	45	46	47	48
	31	32	33	34	35	36	37	38
	21	22	23	24	25	26	27	28
V last stage	11			14			17	

FIG.34

				ì			; I
							i 1
							1 1
							1 1
	1						
	i						
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40			4 =			4.0	1
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12	7		16 1	,		10 1	N 1
10			10			וטו	
	12 13	12	12	12 13 \ 15 \ 16 \	12 13 15 16 16	12 13 15 16 16	12 13 15 18 16 19

FIG.35 V last stage $\frac{1}{\sqrt{1000}}$ **HCCD**

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-	81	82	83	84	85	86	87	88
	71	72	73	74	75	76	77	78
	61	62	63	64	65	66	67	68
	51	52	53	54	55	56	57	58
	41	42	43	44	45	46	47	48
•	31	32	33	34	35	-36	37	38
V last stage	21	22	23	24	25	26	27	28

FIG.36

			·				
	4.4	-					
	11			14		17	
	12.			15		18	
HCCD	13			16		19	

FIG.37

							•
81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38
21	22		24	25		27	28

		_ ♦		Δ		
	11		14		17	
	12		15		18	
HCCD	13	23	16	26	19	

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81	82	83	84	85	86	87.	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38
	22		24	25		27	28

FIG.38

V last stage 22

	÷	14			17		
		15			18		
HCCD	23	16 <	<u> </u>	26	19 <	_	29

FIG.39

81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38
21			24			27	

	_ ♦		♦		 \triangle
		14		17	
	22	15	25	18	28
HCCD	23	16	26	19	 29

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81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38
21			24			27	

FIG.40

V last stage

		14			17		
	22	15	1	25	18	28	
HCCD	23	16		26	19 ~	 29	

FIG.41

	1						
		<u>.</u>					
81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38

		!						l	
		l				· ·	ľ		
	21	14	Į.	24	17		27	ļ	
HCCD	22	15	l	25	18		28		
HCCD	23	16		26	19		29		

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			1				
81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38

FIG.42

V last stage

	21	14	·	24	17	27	110
	22	15		25	18	28	111
HCCD	23	16		26	19	29	112

FIG.43

L								
L	81	82	83	84	85	86	87	88
	71	72	73	74	75	76	77	78
	61	62	63	64	65	66	67	68
	51	52	53	54	55	56	57	58
	41	42	43	44	45	46	47	48
	31	32		34	35		37	38

V last stage

HCCD

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	,	-	<u> </u>				
81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32		34	35		37	38

FIG.44

V last stage

	14		24	17		27	110	
	15 ·	∤	25	18 ·	√ —	28	111	
HCCD	16	33	26	_19	36	29	112	39

FIG.45 V last stage HCCD

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		Γ	İ]	Γ	
	81	82	83	84	85	86	87	88
	71	72	73	74	75	76	77	78
	61	62	63	64	65	66	67	68
	51	52	53	54	55	56	57	58
	41	42	43	44	45	46	47	48
V last stage	31			34			37	

FIG.46

		24	17		27	110		210
	32	25	18	35	28	111	38	211
HCCD	33	26	¹ 19	36	29 \$	1112	39	212

FIG.47 V last stage HCCD

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FIG.48

G81	R82	G83	R84	G85	R86	G87	R88
B71	G72	B73	G74	B75	G76	B7.7	G78
G61	R62	G63	R64	G65	R66	G67	R68
B51	G52	B53	G54	B55	G56	B57	G58
G41	R42	G43	R44	G45	R46	G47	R48
B31	G32	B33	G34	B35	G36	B37	G38
G21	R22	G23	R24	G25	R26	G27	R28
B11	G12	B13	G14	B15	G16	B17	G18

FIG.49

V last stage

HCCD

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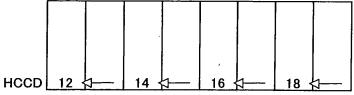
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	81	82	83	84	85	86	87	88
-	71	72	73	74	75	76	77	78
	61	62	63	64	65	66	67	68
	51	52	53	54	55	56	57	58
	41	42	43	44	45	46	47	48
	31	32	33	34	35	36	37	38
·	21	22	23	24	25	26	27	28
V last stage	11		13		15		17	
		\Diamond		\downarrow		\Diamond		
HCCD		12		14		_16		18

FIG.51

FIG.50



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	81	82	83	84	85	86	87	88
	71	72	73	74	75	76	77	78
	61	62	63	64	65	66	67	68
	51	52	53	54	55	56	57	58
:	41	42	43	44	45	46	47	48
	31	32	33	34	35	36	37	38
·	21	22	23	24	25	26	27	28
V last stage	_							
	\Diamond		\Diamond		\Diamond		\Diamond	
								·
	11		13		15		17	
HCCD	12		14		16		18	

FIG.53

FIG.52

V last stage

> HCCD

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	T		T	ĺ	Ι	l .	1
81	82	83	84	85	86	87	88
71	72	73	74	75	76	77	78
61	62	63	64	65	66	67	68
51	52	53	54	55	56	57	58
41	42	43	44	45	46	47	48
31	32	33	34	35	36	37	38
21	22	23	24	25	26	27	28

FIG.54

V last stage

		-					
HCCD	13 14	\downarrow	15 16		17 18	 	19 110

FIG.55 V last stage \triangle HCCD 21 Inventor: NAGAYOSHI et al. Docket No.: 10873.1355US01

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				<u> </u>	•			
	81	82	83	84	85	86	87	88
	71	72	73	74	75	76	77	78
	61	62	63	64	65	66	67	68
	51	52	53	54	55	56	57	58
i	41	42	43	44	45	46	47	48
	31	32	33	34	35	36	37	38
V last stage		22		24		26		28

FIG.56

1 1
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29
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FIG.57 V last stage

 \triangle $^{\wedge}$ HCCD

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FIG.58

(81	82 ^C	83	84 (85	86	87	88
	71	72	73 ^C	74	75 ^C	76	77 ^C	78
(61	62 C	63	64 ^C	65	66 ^C	67	68 ¢
	51 C	52	53 (54	55 C	56	57 ^C	58
C	41	42 ^C	43	44	45	46	47	48
	31	32	33 🤆	34	35 C	36	37	38
C	21	22	23	24	25	26 C	27	28
	11 \$	12	13	14	15 ¢	16	17 🤇	18